CHAPTER 5

Plant and Crop Response

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Abundant, affordable, and safe food supplies are largely taken for granted. It is hard for Americans to imagine a world in which radical shortages of food could not be quickly remedied by a trip to the local Wal-Mart Super Center. A simple, elegant attack on a few U.S. crops could result in a ripple through our food sector and economy with devastating consequences. An agroterrorism event would cause economic losses to individuals, businesses, and the U.S. Government as a result of the costs to contain and eradicate the disease, and to dispose of contaminated products. Is the U.S. military organized, trained, and equipped to defend against such an agroterrorism event?

The potential of terrorist attacks against agricultural targets such as plants and crops is a threat to U.S. national security due to its impact on the U.S. economy. Today, multiple federal agencies effectively fill critical roles in the response to natural and man-made crop disease epidemics. The role of the U.S. military, however, is unclear and therefore little has been accomplished to prepare for military support in the event of a terrorist act against crop and plant resources. Nevertheless, the threat of agroterrorism is real, and the adverse impacts on the U.S. security could be staggering without considerable Department of Defense (DoD) preparation.

Plant and Crop Economics

Agriculture and food industries are very important to the social, economic, and political stability of the United States. In 2002, the food and fiber sector contributed $1.2 trillion, or 11% to the gross domestic product. Gross farm sales exceeded $200 billion in a relatively concentrated area throughout the Midwest, parts of the East Coast, and California. Production is split nearly evenly between crops and livestock.

Although farming employs less than 2% of the country's workforce, 16% of the workforce is involved in the food and fiber sector.[1,2,3]

Despite the large numbers of people employed in the agriculture and food industry, the production assets are relatively localized and thus present a lucrative target for a terrorist. Although the number of farms in the 2002 Census of Agriculture totaled 2.1 million, 75% of the value of production occurs on just 6.7% or 143,500 of these farms reflecting the concentrated nature of this strategic resource. This subset of farms has average sales of $1 million annually, and averages 2,000 acres in size.[4] As crop production and harvesting technology, and genetic engineering progresses, the number of farms will decrease since fewer people and farms are required to produce the necessary food.

An agroterrorism attack on crops would have tremendous impact on U.S. exports. The U.S. produces and exports a large share of the world's grain. In 2002, U.S. exported $53 billion in agricultural products. The U.S. share of world production was 39% for corn, 38% for soybean, and 8% for wheat. The United States accounted for 23% of global wheat exports, 54% of corn exports, and 43% of soybean exports.[5] Thus, protection of this U.S. resource is critical to maintaining our economic health in the world market.

Unique Characteristics of Agriculture

Agriculture has several characteristics that pose unique problems for managing an agroterrorism threat. First, agriculture production is geographically dispersed in unsecured environments, such as open fields and pastures throughout the countryside, making crops an easy target to sabotage. Second, the presence, or rumor of presence, of certain pests or diseases in a country can reduce demand or quickly stop all exports of a commodity which can take months or years to resume. An additional result of pests or diseases can be a decline in the demand for some foods based on the products targeted in the attack (e.g., grains, fruits, or vegetables), while demand for other types of food may increase due to the resulting food substitutions. Finally, crop and plant disease outbreaks are difficult to detect, which makes an agroterrorist event even more challenging to manage.

A recent example of export related economic consequences caused by an agricultural pathogen and its disease is karnal bunt, caused by the

fungus *Tilletia indica*. Although the disease does not have a significant effect on crop yield, nearly 80 countries banned wheat imports from regions with karnal bunt infection. When the disease was discovered in Arizona and surrounding areas in 1996 (presumably from an accidental introduction from Mexico), there was an immediate threat to the overall $6 billion per year U.S. wheat crop, of which 50% is exported. From 1996 to 1998, the U.S. Department of Agriculture Animal and Plant Health Inspection Service spent over $60 million on the eradication effort, and growers in this small affected area lost well over $100 million from decreased sales and increases in production costs.[6]

Plant and crop disease outbreaks are difficult to detect. Even if a farmer closely monitors his crops, a lack of direct experience with foreign plant diseases may delay recognition of symptoms in event of an outbreak. Recognition is made more difficult because the number of lethal and contagious biological agents is greater for plants than for humans. In addition, it may be hard to distinguish a biological attack from a natural disease outbreak. Signs of infection may be manifested slowly, delaying effective response by individuals and/or authorities.[7,8] Next, most of these diseases are environmentally resilient, endemic in foreign countries, and not harmful to humans – making it easier for terrorists to acquire, handle, and deploy the pathogens. Finally, limited genetic diversity in most U.S. agriculture species may make those species particularly vulnerable to specific pathogens. Thus, the general susceptibility of the agriculture and food industry to agroterrorism is difficult to address in a systematic way.[9,10,11,12,13,14]

Potential Agroterrorism Targets

The disquieting characteristics described above are manifested in five potential targets of agricultural bioterrorism. These potential targets include:

1. field crops;
2. farm animals;
3. food items in the processing or distribution chain;
4. market-ready foods at the wholesale or retail level; and
5. agricultural facilities.

The fifth potential target includes processing plants, storage facilities, wholesale and retail food outlets, elements of the transportation infrastructure, and research laboratories. The agricultural industry's widespread vertical integration, in which a single company controls much of the commodity production, processing, and distribution system, also facilitates the geographical spread of pathogens and contributes to United States vulnerability.[15,16] Examination of these targets reflects that America is exceedingly susceptible to agroterrorism.

From the economic impact, characteristics, and targets described here, it is obvious that preparation for and response to an agroterrorist attack against crops is complex and critical to our national well-being. The preparation and response involves the cooperative efforts of multiple state and federal agencies, including the DoD.

Agroterrorism Response: Roles & Responsibilities of Federal Agencies

The goal of the U.S. animal and plant health safeguarding system is to prevent the introduction and establishment of exotic pests and disease, to mitigate their effects when present, and to eradicate them when possible. In an outbreak, damage is proportional to the time it takes to first detect the disease. If a foreign pest disease is introduced, responsibility for recognizing initial symptoms rests with farmers, producers, veterinarians, plant pathologists and entomologists. The last line of defense, and the costliest, is the isolation, control, and eradication of an epidemic.[17]

The U.S. Government has published the Public Health Security and Bioterrorism Preparedness and Response Act and the Homeland Security Presidential Directive 9 to direct the appropriate federal agency to act in protection of agriculture. These documents and several responsible federal agencies are detailed in this section.

The Public Health Security and Bioterrorism Preparedness and Response Act (Public Law 107-188, June 12, 2002) contains several provisions important to agriculture, including:[18]

- expand Food and Drug Administrations (FDA) authority over food manufacturing and imports;

- tighten control of biological agents and toxins through rules issued by the U.S. Department of Agriculture Animal and Plant Health Inspection Service and the Centers for Disease Control and Prevention (CDC); and
- authorize expanded agricultural security activities and security upgrades at USDA facilities.[19]

Homeland Security Presidential Directive-9 (HSPD-9) established a national policy to protect against terrorist attacks on agriculture and food systems.[20] This directive instructs agencies to develop awareness and warning systems to monitor plant and animal diseases, food quality, and public health through an integrated diagnostic system. Animal and commodity tracking systems are included, as is gathering and analyzing international intelligence. Vulnerability assessments throughout the sector help prioritize mitigation strategies at critical stages of production or processing, including inspection of imported agricultural products.[21]

The U.S. Environmental Protection Agency (EPA) has established a permanent National Homeland Security Research Center based in Cincinnati, Ohio, with the following divisions:

- threat and consequence assessment;
- decontamination; and
- consequence management and water infrastructure protection.

In this center, the Environmental Protection Agency will ensure effective design, implementation, and oversight of the research. Additionally, the Environmental Protection Agency will provide clear lines of communication and facilitate interaction within the Environmental Protection Agency and other federal agencies, universities, and private sector and research partners.[22]

The National Plant Diagnostic Network (NPDN) is a consortium of five regional networks and a national database (Figure 5.1). The National Plant Diagnostic Network was established in June 2002 by the United States Department of Agriculture and the U.S. Department of Homeland Security (DHS) as a key component of a national plant biological security program.[23] The National Plant Diagnostic Network is linked to the National Agricultural Pest Information System (NAPIS) to facilitate the rapid exchange of diagnostic information, trends, and alerts.[24] A secure

agricultural system requires rapid detection of outbreaks, accurate diagnoses of problems, and prompt response to minimize impact. The National Plant Diagnostic Network must be supported and enhanced to improve the diagnostic and detection system in the event of a deliberate or accidental disease outbreak.[25,26,27]

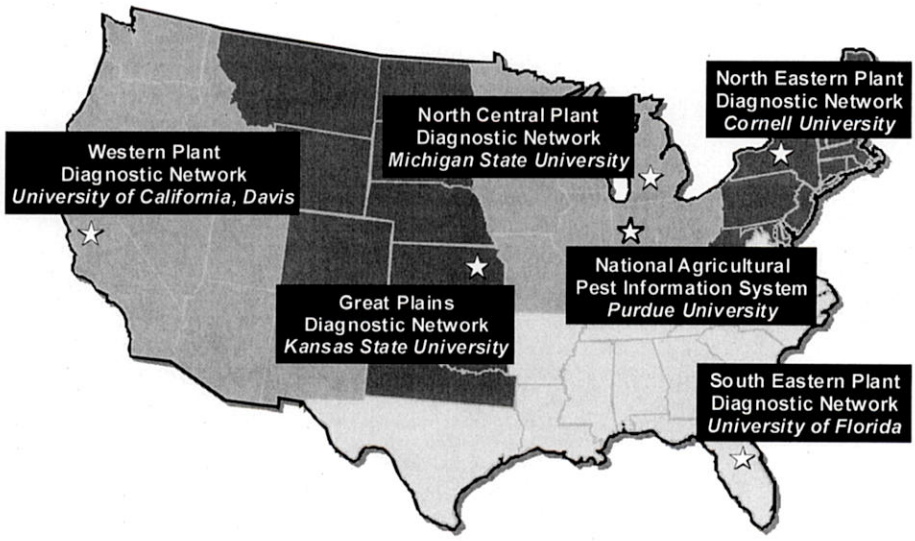

Figure 5.1 National Plant Diagnostic Network Regional Centers

The Animal and Plant Disease and Pest Surveillance & Detection Network was established in response to the charge from the Secretary of Agriculture to Cooperative State Research, Education and Extension Service (CSREES) to develop a network linking plant and animal disease diagnostic facilities across the country. The National Plant Diagnostic Network focuses on the plant disease and pest aspect of the program. The network is a collective of Land Grant University plant disease and pest diagnostic facilities from across the United States. Lead universities have been selected and designated as Regional Centers to represent five multi-state regions across the country. The National Agricultural Pest Information System has been designated as the central repository for archiving select data collected from the regions. Colorado State University is one of nine state members of the Great Plains Diagnostic Network Regional Center coordinated from Kansas State University.[28]

Despite the extensive protection offered by the agencies detailed here, the DoD may provide critical assets and capabilities to enable more thorough protection and response.

Type and Magnitude of Military Support

DoD has no clear responsibility for responding to terrorist attacks on U.S. civilian personnel and facilities. While DoD would assume primary leadership in the event of terrorist attacks on domestic military installations and personnel, the probable collateral effects on civilian populations (particularly if biological weapons are employed) would necessitate shared responsibilities and close coordination with civilian agencies. Many authors have proposed involving multiple federal strategies to respond to the agroterrorism threat. Components of these strategies proposed should include involvement of the Defense Department to develop a more effective defense.

In 2002, Dr. Henry Parker defined a federal strategy to meet the agroterrorist threat.[29] He proposed *Preventive Measures* which include:

- intelligence measures (identify potential threats and perpetrators, motivations, predict behavior);
- monitor programs (detect and track specific pathogens and diseases);
- targeted counter-terrorism research;
- international counterproliferation treaties, protocols, and agreements;
- creation of agent-specific resistance in livestock, poultry, and crops;
- vaccination against specific biological weapons agents;
- modification (where possible) of vulnerable U.S. food and agricultural practices to minimize impacts of terrorist acts; and
- education and training (federal, state, and local).

Dr. Parker also proposed *Response Measures* that should focus on:

- consequence management;
- early detection of specific biological weapons agents, delivery mechanisms, origins, and targets;
- early management to stop disease spread and minimize infection;
- epidemiology and treatment;
- various responses (diplomatic, military, legal, economic), compensation and indemnification;
- education and training (federal, state, and local); and
- public awareness and education programs.

After reviewing these prevention and response measures, several can be seen to include a military component. For instance, the DoD could provide assets in support of the *Prevention Measures* of intelligence and monitoring programs. In addition, the military could assist in the military response aspects of *Response Measures*. Finally, in addition to these measures, the DoD could provide assets, manpower, and experience in the Command, Control and Communication arena. Each of these potential military roles will be address in detail here.

Intelligence and Monitoring

A national strategy to protect food and agriculture must be strongly linked to other national security and counterterrorism programs. It should also involve strategic partnerships with other federal, state, and local agencies and non-governmental organizations. For example, the DoD should assist in the development of well-coordinated federal interagency mechanisms for gathering, assessing, and sharing sensitive intelligence information among the Federal Bureau of Investigation (FBI), Central Intelligence Agency (CIA), the United States Department of Agriculture, and DoD concerning hostile threats to U.S. food and agriculture.[30]

The DoD utilizes multiple sources of space-based monitoring to collect intelligence data. To enable real-time detection of agroterrorism, the DoD should enhance intelligence monitoring to include a 24-hour network of remote sensing satellites and ground truth support in priority crop areas and food processing/distributing centers. These areas could

include primary acreage for commodities such as corn, wheat, rice and soybean (Figure 5.2) in addition to more specific vegetable and fruit production areas that are typically located close to major metropolitan areas (e.g., Los Angeles, Seattle, Denver, Phoenix, Chicago, St. Louis, Dallas, New York, and Miami).[31] Currently, the United States Department of Agriculture uses remote sensing to observe seasonal variations in plant vegetation (Figure 5.3).[32] Enhanced satellite monitoring by the DoD would enable a more accurate sensing of initial plant pest outbreaks and agroterrorism.

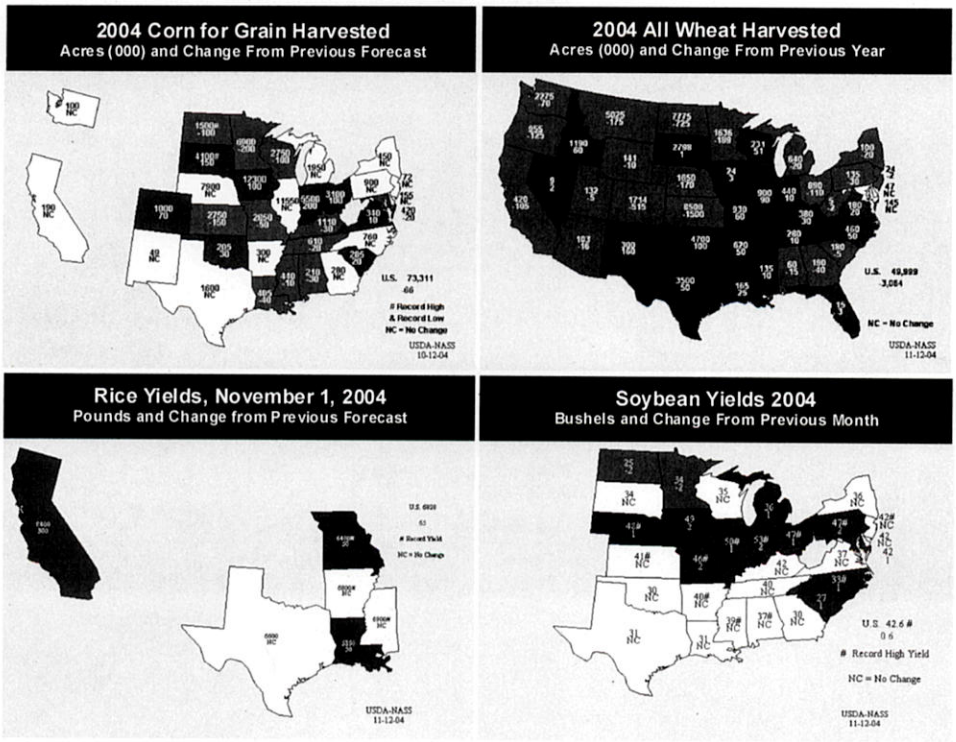

Figure 5.2 United States Crop Production Centers, 2004

These graphics illustrate crop production figures collected by the United States Department of Agriculture; colors denote a decrease (light gray), increase (dark gray), or no change (white) in production values from the previous season.[33]

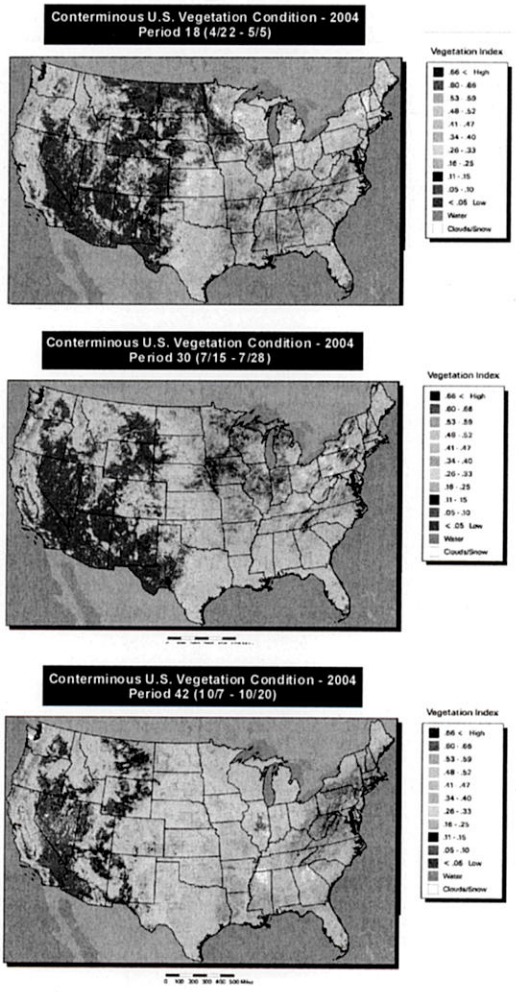

Figure 5.3 Remote Sensing of Plant Vegetation and Monitoring for Initial Plant Pest Outbreaks, 2004

These figures illustrate continental U.S. ground vegetation for selected 14-day periods during 2004. Higher resolution versions of these satellite images on a 24-hour monitoring basis could detect initial agro-terrorist events that impacted crop health, and contribute to more rapid and successful mitigation efforts.[34]

One of the best defenses against the introduction of new plant diseases, by either accidental or deliberate means, is rapid detection. One mission of the plant pathology research program of the United States Department of Agriculture Animal Research Service (ARS) Foreign Disease-Weed Science Research Unit at Ft. Detrick, Maryland, is development of rapid molecular-based systems for detection of naturally introduced foreign pathogens for use by the Animal and Plant Health Inspection Service, DoD, federal and state agencies, and universities. There are more than 500 pathogens that can cause major disease losses. Thus, a reliable methodology for rating and prioritizing those pathogens of the highest risk is essential.[35,36] Members of the DoD should be identified, trained, and equipped to serve in this anticipated monitoring capacity.

Plant diseases can materialize or be spread due to the weather. The DoD utilizes military meteorologists in its daily operations. These meteorologists could monitor regional, national, and international weather patterns (especially wind and moisture) which could contribute to a pest outbreak. More importantly, the personnel could rapidly identify downwind movement and targets that could be threatened by the secondary spread of a pest(s). Only minimal training would be required to enable DoD meteorologists to assist in determining conditions conducive to pest outbreaks or conditions and a greater spread of disease.

Military Response Measures

The U.S. military, especially state National Guard forces, could be used as a manpower resource to assist in the depopulation (eradication) and disposal of infested plant materials and food products. In the event of an agroterrorist attack, it may be necessary to complete a large scale eradication of infested plant materials and food products, and decontamination (fumigation, sterilization) of infested equipment and infrastructure (e.g., grain elevators, train cars) affected by the agents. Detailed coordination between the United States Department of Agriculture and National Guard forces must be accomplished to ensure an accurate assessment of capabilities the state can expect from the DoD.

In response to a real or perceived threat, Guard personnel may also be used to provide security for resources such as chemicals, equipment, personnel, and implementation of quarantine and containment actions. In

addition, security forces can safeguard regional supplies for the protection of un-infested crops near major agricultural production and food product handling centers to mitigate the spread of the pest(s) from the initial outbreak foci.

For all military responses, the DoD and USDA should create and maintain a network of regional centers near major agricultural production regions to support a rapid, 24 to 48 hour, response.

Command, Control, and Communication

Effectively coordinated and rapid responses require integrated electronic field diagnostic and communication systems and emergency control centers that can take advantage of the very latest information and data management technology. The DoD has extensive capabilities and experience in developing effective Command, Control, and Communication systems. The DoD could assist in the development of a coordinated, nationwide electronic communications and data management network to link the private agribusiness community with emergency management staff; field response personnel; and key DoD, federal, state, and local agencies. This network could facilitate pathogen monitoring, reporting and tracking diseases, and communicating response measures and their effectiveness.

Conclusions

In order to affect a comprehensive agroterrorist capability to protect plant and crop resources, DoD needs to develop strategic plans and establish partnerships between the United States Department of Agriculture (the United States Department of Agriculture Animal Research Service, the Animal and Plant Health Inspection Service, Cooperative State Research, Education and Extension Service), DoD, CIA, FBI, Department of Homeland Security, state and local government agencies, private sector commodity groups, universities, and professional societies like the American Phytopathological Society. Establishing and strengthening these partnerships with resources and trained personnel could expand the national infrastructure and enhance operations support and rapid response.

In terms of crop and plant response, the military's role must be pervasive and interwoven throughout the nation's homeland security fabric and strategies. A safe and dependable supply of food for our citizens is one of the most critical operative mandates for the Department of Defense. The military's defense strategies must encompass comprehensive and state-of-the art approaches to reduce opportunities for agroterrorist events. Military response strategies must also encompass aggressive and timely actions to mitigate and eradicate the impact of agroterrorism on our plant and crop resources. A strong and well-trained military will not only provide the backbone for U.S. homeland defense infrastructure but will also enhance the implementation of Department of Homeland Security strategies dealing with national and international intelligence, monitoring, security, mitigation, and communication networks.

Notes

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